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Investigating the Impact of Climatic Events on the Subsistence of Mesolithic and Neolithic Communities Around the Caspian Sea

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Abstract

Climatic changes in the late Pleistocene and early Holocene, which had a great impact on the transgression and regression of the Caspian Sea levels, were simultaneous with Mesolithic and Neolithic settlements around the sea. The frequent changes in the Caspian Sea level have directly and indirectly affected the early settlements of prehistoric societies around the Caspian Sea. The impact of these changes and the reaction of humans is the main subject of this research. Despite the importance of this issue, it has not been studied well related to Caspian Sea research, and it is necessary to explain a model for the response of these communities to climate change. In this paper, with an analytical approach, the subsistence of the communities around the Caspian Sea during the transgressions and regressions of the sea level has been discussed. The Khvalynian (18,000-12,000 BP) and Neo-Caspian (10,600-8,400 BP) transgressions caused marine species to play a significant role in the sustenance of these communities, among other resources. The Mangyshlak (12000-10500 BP) and 8.4k (8400 BP) regressions caused a large distance between the identified sites and the sea shores, and as a result, the use of marine resources in the residents' sustenance decreased; but on the other hand, it caused the formation of rich ecosystems for new animals and plants such as gazelles, goats, and sheep. On the southeastern shores of the Caspian Sea, the beginning of Mesolithic settlements was almost simultaneous with the Khvalynian transgression and the proximity of the coasts to the sites, and these settlements continued until later periods. In the eastern Caspian Sea, settlements appear after the end of the Khvalynian transgression and during the Mangyshlak regression. During this period, the sea was still close to the settlements. While in the west, in the middle of the Khvalynian transgression, settlements were in the Upper Paleolithic, and in the north, there was no settlement until about 10,000 BP. While almost most of the communities in West Asia, at the end of the Pleistocene and Early Holocene, began the domestication and food production; the richness of the regions around the Caspian Sea could easily provide the sustenance needs of its communities and the first domestic species appeared only in the west and north at the Eneolithic period.

Keywords: Climatic Events, Sustenance, Mesolithic and Neolithic, The Caspian Sea Shores, Pleistocene and Holocene, Transgression and Regression, Domestication and Food Production.

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Introduction

The Caspian Sea, which is the world's largest lake with an area of approximately 370,000 square kilometers, is located in Western Asia. The climatic changes in the late Pleistocene and early Holocene have affected the Caspian Sea level changes, the distribution pattern of the ancient sites, and the sustenance of the communities of the sea shores. During the Last Ice Age, the water resulting from the evaporation of the ocean surface is condensed in the form of huge ice masses and disrupts the normal circulation of water. The density of water on the surface of the land causes the water level of the open seas to drop. On the contrary, during the interglacial period, the evaporation of the ocean surface caused the sea level to rise, sometimes resulting in a height between 100 and 200 meters; therefore, part of the coastal shores will be flooded; for example, the southern parts of the Caspian Sea and the Krasnovodsk Peninsula were submerged during the periods of sea transgression. Environmental diversity in coastal zones is directly related to sea level changes. Transgressions cause submerging processes and the rise of underground water levels and therefore the development of vegetation in a newly formed environment, while regressions lead to a decrease in coastal environmental diversity (Lychagin, 2010). Glacial/interglacial cycles have also caused changes in the flow of rivers around the Caspian Sea basin. At the beginning of the Pleistocene, the Amu Darya River flowed to the east of the Caspian Sea and created an alluvial plain; but in the later stages of the Pleistocene, by changing its direction to the Aral Sea basin, the plain of Karakum turned into a sandy desert, which today is one of the largest deserts in the world. Climatic conditions and the frequent transgressions and regressions of the Caspian Sea have affected the life of the inhabitants. The Authors discuss the Caspian Sea level changes in the late Pleistocene and early Holocene and their role in the sustenance of simultaneous societies.

Questions and Hypotheses: What was the impact of Caspian Sea level changes on the formation of settlements around it in the late Pleistocene and Holocene?

The settlements in the south and west of the Caspian Sea were formed during the Khvalynian transgression, which is the maximum rise of the sea in the late Pleistocene. The settlements appear in the east with the beginning of the Mangyshlak regression and in the north with the Neo-Caspian transgression.

What has been the reaction of communities to climate and the Caspian Sea level changes in terms of subsistence? Considering the very rich

ecosystem and abundant animal and plant resources that existed around the Caspian Sea, human communities adapted to the environment by changing their subsistence from marine resources to plain resources in the periods of sea transgressions and regressions, and this adaptation caused food production and domestication to occur much later than other regions of West Asia.

Research Method: The Authors used the analytical method in this research. Most of the research in this field has only targeted the end of the Pleistocene and the beginning of the Holocene, but in this article, the Authors discuss the important issue of subsistence until the middle Holocene and the first appearance of domesticated species, and its relationship with climate and sea level changes.

Research Background

Among scholars such as Leroy and her colleagues (2019), Shnaider (2021), Sigari (2016), and Farajova (2017) studied the Caspian Sea level changes and its impact on the settling down and their subsistence, but these studies have been limited to certain regions around the Caspian Sea. Even though the transgressions and regressions of the Caspian Sea have influenced the formation of settlements and the subsistence of the communities around it, it has not been much addressed (Vahdati Nasab & Nikzad, 2016; Vahdati Nasab et al., 2020) or incorrect results have been deduced from it (Ramezanpour et al., 2014). The current research intends to study and analyze the response pattern of human societies to climate and environmental changes with a trans-regional perspective on the transgressions and regressions of the Caspian Sea.

Mesolithic and Neolithic around the Caspian Sea

- The Southeastern Caspian Sea

The Mesolithic sites in the southeast of the Caspian Sea (Fig. 1) include caves of Hotu and Kamarband (Coon, 1951; 1952; Fazeli Nashli, 2021a, 2021b), Al Tappeh (McBurney, 1964, 1968), Komishan (Vahdati Nasab, 2009), and Komishani open site (Fazeli Nashli, 2017). Currently, these sites are located at a distance of 20 to 25 km from the Caspian Sea coastal shores and a maximum height of 100 meters from the AMSL¹. The Mesolithic in this region is generally divided into two periods: The Early (15,000 to 13,000 BP) and the Late (11,000 to 9,500 BP) Mesolithic. In the early Mesolithic (layers 28 to 21 of Kamarband and depth of 10.15-11.15

meters in Hotu), a large number of remains of seal and waterfowl along with gazelles, aurochs, horses, boars, and deer were found; Coon refers to this period as seal hunters (Coon, 1951). The oldest Mesolithic layers in the recent excavation of Hotu Cave (Fazeli Nashli, 2021a), according to new absolute dating, dated to 14,000 years ago (11,945 BC). The animal remains obtained from the Mesolithic layers show the dominance of the gazelles with 64%, then seals with 14% of the total animal findings (De Groene et al., 2023). In the Late Mesolithic (layers 17 to 11 in Kamarband and depth 10.15 to 7.65 in Hotu Caves), the main food of people was steppe animals, including Iranian gazelle, which still can be found in the Turkmen plain; Coon named this period gazelle hunters (Coon, 1951). The deposits of Al Tappeh Cave, which dated from 12,400 to 10,800 BP (McBurney, 1968), belong to the Late Mesolithic. McBurney has divided the 23 layers identified in this cave into 5 main stages based on the amount of animal remains and according to the absolute dates of the deposits. In stages I, III, and IVb, gazelle was the dominant element, but in stages II and IVa, gazelle decreased and seals increased significantly. The changes in the dominance of gazelles and seals in different periods of settlement can indicate climatic changes and the transgressions and regressions of the Caspian Sea (McBurney, 1968), but the dates and the occupy stages are not compatible with climatic and sea level changes.

The oldest layer of Komishan Cave, with in-situ deposits, (13,771 to 12,628 BP), belongs to the Late Mesolithic (Vahdati Nasab et al., 2011). The largest number of animal species identified in the Kamishan cave belonged to medium-sized mammals, which were classified in the category of caprine and gazelles. The amount of large mammals increases in the upper layers, but small mammals are present in almost all layers. Gazelles are the most common type of mammals that are abundantly seen in the upper 6 layers, and instead boars, carnivores and caprine has decreased in these layers. Other mammals, in order of their amount, include wild boar, aurochs, Persian yellow deer, red deer (*Cervus elaphus*), sheep, wolf, rabbit, and hedgehog. The most number and variety of bird species belong to the first 6 layers, and in layer 9, there seems to be equality between birds and mammals. The highest amount of bird species belongs to large and small bustards. The fruit seeds in most layers, along with the absence of cereal grains (except a few barley grains in the upper disturbed layers and a few small lentils between 1.2 and 2.5 mm in size), indicate a plant economy based on wild species, rather than cereal species (Vahdati Nasab et al., 2020: 113). The oldest dating presented for the Komishani open site

refers to the Late Mesolithic period (around 9200 BC) (Fazeli Nashli et al., 2017). Among the animal remains of layers 13 and 14 of this site, which belong to the Mesolithic period, medium-sized mammals, followed by ovis and medium-sized are dominant (Farshi Jalali, 2020).



Fig. 1: Mesolithic and Neolithic sites in the southeast of the Caspian Sea: A) Kamarband Cave (Authors; Coon, 1951); B) Al Tappeh (Authors; McBurney, 1968); C) Hotu Cave (Authors; Coon, 1952); D) Komishan Cave (Vahdati Nasab et al., 2011); E) Komishani open site (terrace in front of Komishan cave) (Fazeli Nashli, 2016). ►

- Eastern Caspian Sea

In the east of the Caspian Sea, the evidence of Mesolithic and Neolithic communities has been obtained in the Bolshoi Balkhan region (Dem Dam Cheshme 1 and 2, and Djebel rock shelters), the Krasnovodsk Peninsula (Kaylu and Kuba-Sengir rock shelters) and the Kara-Bogaz-Gol gulf (Hodja-su cave) (Fig. 2). The Dam-Dam Cheshme 1 and 2 caves are located in Bolshoi Balkhan mountains near the Balkhan-Abad city and were first excavated in the 1950s by Alexey Okladnikov, then in the 1960s by Gennady Markov and 1997 by the British group and David Harris. Markov introduces 5 chronological horizons from the Upper Paleolithic to the Bronze Age for Dam-Dam Chashmeh 1. Despite the lack of absolute dating, Markov believes that the transition from the Mesolithic to the Neolithic occurred in layer 4 (Coolidge, 2005: 53-54). Dam-Dam Cheshme 2 is a deep rock shelter in the northeast of Dam-Dam Chashmeh 1, which is located in the adjacent valley. In his archaeological stratification in 1963 and 1964, Markov identified 23 cultural sub-layers and divided them into 9 layers.

Based on the typology of microlithic industries in comparison to the stone industries of the Kamarband and Djebel caves, layer 3 was attributed to two sub-layers, Eneolithic (Chalcolithic) and Late Neolithic. Potteries that are comparable with Kamarband and Djebel (layer 7) have also been identified from layer 5. In layers 7, 8, and 9, which are attributed to hunter

groups, a significant decrease in the size and variety of lithic assemblage can be observed (Coolidge, 2005: 56-57). The subsistence economy of the inhabitants of Dam-Dam Cheshme 2 was based on hunting-gathering-fishing and maybe domestication of animal species in layers 6-9 (the Late Mesolithic and Early Neolithic), which in layers 4-5 (the Neolithic) it changed to a hunting and food production economy. Markov concludes that the cultural layers at Dam-Dam Cheshme 2 indicate the transition to animal husbandry and then to the steppe nomadic economy, which is observed throughout the northern regions to the Urals and the Siberian steppe (Markov, 1966: 91, quoted by Coolidge, 20005: 57). Djebel cave is located in the southern part of the Bolshoi Balkhan, between the mountains and the foothills. The oldest cultural layers of this site (layers 8 and 7) belong to the Mesolithic, layers 6, 5-6 and 5A belong to the transition from the Mesolithic to the Neolithic, layers 5 and 4 is belongs to the Early Neolithic and layers 3, 2 and 1 are considered to the late Neolithic and the early Bronze Age (Coolidge, 2005: 48). Okladnikov has divided the Mesolithic period based on changes in the lithic assemblage from pebble (in layers 8 and 7) to geometric microliths (in layers 6 and 5a), respectively to the Early and Late Mesolithic. The subsistence of the oldest Mesolithic inhabitants of Djebel was based on hunting-gathering, then, in the Early Neolithic was based on fishing, and in the Late Neolithic and the Early Bronze Age was based on sheep and goat herding and wild seed gathering; Gazelle, goat and sheep were the most important animal remains (Coolidge, 2005: 53). Hodja-su, which is located on the eastern coast of Kara Bogaz Gol golf, is a Mesolithic site in the northernmost region of the Caspian Mesolithic. The subsistence of the residents of this site is mainly hunting and fishing, and there is no evidence of a year-round occupation has been found (Jayez, 2011, cited in Korobkova, 1969; Masson & Sarianidi, 1972; Okladnikov, 1953).

Kaylu and Kuba-Sengir are located at the eastern end of Kubadag rocks. The lithic assemblage of the Kuba-Sangir open site, based on the typological similarity with the lithic industries of Bolshoi Balkhan and the southern Caspian Sea, was attributed to the Late Mesolithic and Early Neolithic (Okladnikov, 1966). Obtaining more than 900 seashell beads and a remarkable abundance of personal ornaments made Okladnikov introduce this site as a shell bead workshop (Okladnikov, 1953). In 2018, during the survey of the site by Shnaider and his colleagues, surface findings, including 14 shell beads and 40 lithic artifacts were obtained, which show a great similarity with Okladnikov's assemblage (Shnaider et al; 2021).

Kaylu cave in the north of Bolshoi Balkhan in the Krasnovodsk Peninsula contains Mesolithic and Neolithic layers (Shnaider et al; 2021: 3). It seems that the subsistence of the Mesolithic inhabitants of this site, like Hodja-su, was based on hunting and fishing. In Kaylu, large amounts of fish bones, especially sturgeon fish, stone blades, and shell beads have been found in human burials (Harris, 2010: 58). The current elevation of Kaylu is 4 meters and Kuba-Sengir is 14 meters AMSL. During the Khvalynian transgression, the Krasnovodsk peninsula was submerged. According to the height of the sea level in the late Khvalynian which is 0 meters, the occupation in Kaylu and Kuba-Sengir sites could only have happened after the late Khvalynian in the Early Holocene, in the Preboreal period (Svitoch, 2010). The presence of abundant fish bones, including sturgeon and local oyster species, shows that the site was still located near the sea. Kaylu and Kuba-Sengir sites have been attributed to the Mesolithic and Early Neolithic, based on the typology of lithic industries (Okladnikov, 1966). The revisiting of the lithic assemblages of these sites based on the technological-typological approach indicates two different lithic traditions. The lithic industry of the Kaylu has similarities with the eastern Caspian sites (Dam-Dam Cheshme 1 & 2) and the south Caspian Sea industries in Al Tappeh, Kamarband, and Komishan caves that are attributed to the Mesolithic and 12000-10000 BP. The lithic industries discovered in Kuba-Sengir can be compared to the hunter-fishers' lithic assemblages of the lower Ozboy and Oyuklin, and also the Neolithic assemblage from Komishan cave, between 9,000-7,000 BP (Shnaider et al., 2021: 3).

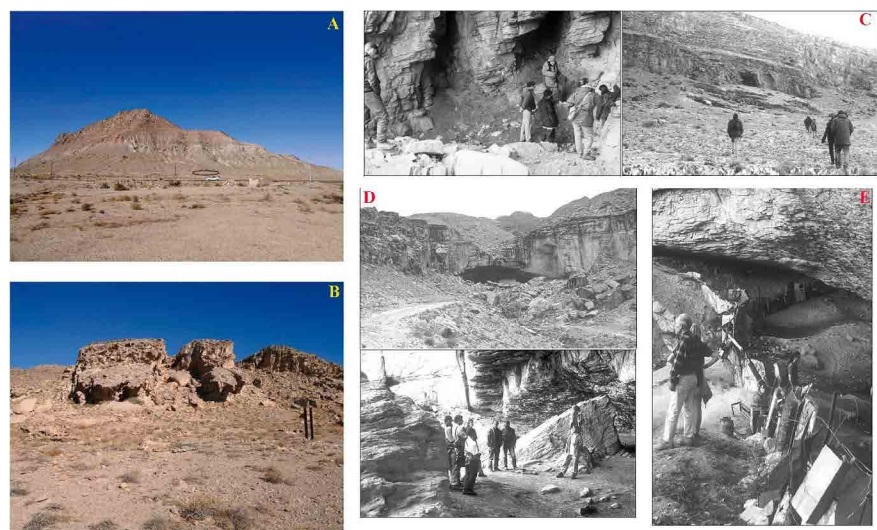


Fig. 2: Mesolithic and Neolithic sites in the eastern Caspian Sea: A) Kuba-Sengir B) Kaylu (Shnaider et al., 2021) C) Djebel Cave D) Cheshme 1 E) Dam-Dam Cheshme 2 (Coolidge, 2005). ►

Table 1: Comparison of Archaeological periods, sea fluctuations, and climate changes in the eastern and southeastern parts of Caspian Sea (Author). ▼

Geological Periods	Archaeological Sites and Periods			Sea Level Changes		Climate Changes
	Periods (BP)	Southeast	East	Periods	Dating (BP)	
Holocene	Pottery Neolithic 8600-7500	Kamarband, Hotu, Touq Tappeh, Tappeh Valiki	Dam-Dam Cheshme 1 & 2, Djebel, Kaylu	8.4k Regression	8400	Holocene
	Pre-Pottery Neolithic 9500-8600	Kamarband, Hotu, Komishani Open Site	Dam-Dam Cheshme 1 & 2, Djebel, Kaylu, Kuba-Sengir	Neo-Caspian Transgression	10590-8400	
Pleistocene	Late Mesolithic 11000-9500	Kamarband, Hotu, Komishani Open Site, Komishan Cave, Al Tappeh	Dam-Dam Cheshme 1 & 2, Djebel, Kaylu, Kuba-Sengir, Hodja-su	Mangyshlak Regression	11900-10500	Younger Dryas 12800-11550 BP
	Early Mesolithic 15000-13000	Kamarband, Hotu, Komishani Open Site, Komishan Cave, Al Tappeh		Late Khvalynian Transgression	18000-12000	Allerød Older Dryas Bölling

- Western Caspian Sea

Recent excavations in Gobuстан in eastern Azerbaijan, a few kilometers from the Caspian Sea, provide new data for the Upper Paleolithic and Mesolithic (Fig. 3). Melahat Farajova has reconstructed the environment in the Upper Pleistocene and Holocene based on the rock motifs (from the Upper Paleolithic to Medieval Age) identified in this region and the C14 and AMS dating. The Upper Paleolithic on the western coast of the Caspian Sea has so far been identified only in the Gobuстан and it is divided into two phases: Early Upper Paleolithic (14000 to 12000 BP), and Late Upper Paleolithic (12000 to 10000 BP). Pictures of the heads and full bodies of the aurochs in natural size in Gaya Arasy Cave in Kichikdash Mountain and Ana Zaga Cave in Buyukdash Mountain are related to the Early Lower Paleolithic; also, pictures of the boat (Sigari, 2016) were recorded in this period. Images of the aurochs are still found in the Late Lower Paleolithic along with the wild horse from fauna assemblage in this period (Farajova, 2017, 2018) (Fig. 4 & 5).

The Mesolithic in the west of the Caspian Sea generally dated between 12,000 and 8,500 BP (Sagona, 2018). Since the beginning of the 1960s, the traces of the Mesolithic in Gobuстан were revealed during archaeological excavations in sites such as Ana Zaga, Kaniza, Ovchular, Okuzler, Okuzler 2, Maral, Dashalti, Jeyranlar, Gaya Arasy and Gaya Arasy 2. These sites

include caves which were used as settlements for a long time. Based on the Mesolithic rock arts (between 10,000 and 9,000 BP), such as motives of hunters, boats, and aurochs which have been identified from sites such as Okuzler 2 and Kaniza from the upper terrace of the Buyukdash, and Gaya Arasy, Firuz I and Firuz II from Kichikdash and Shungar mountains. The inhabitants of the Gobuстан region lived on the coast of the Caspian Sea during the Mesolithic period and hunted seals and gazelles. 98% of the animal remains in the Gaya Arasy Cave in Kichikdash Mountain consist of big gazelle bones; therefore, the Mesolithic in Gobuстан region has been called “Gazelle Mesolithic”. At the time of occupation of Gaya Arasy Cave, the landscape of the Gobuстан was a plain where a large number of Gazelles and Kulan² grazed. Six Mesolithic sites in the North Caucasus, such as Chokh, Mekegi, Kozma-Noho, and Shao-Leget, are located in the mountain’s mid-lands, which shows that the post-glacial natural-geographical conditions of the region gave them the possibility to settle in highlands, as well as along river deltas, and sea coasts (Farajova, 2018). In the Mesolithic art of the North Caucasus, bezoar goats, and bison are painted on the walls of Chuval-Khvarabnokho and Chiyana-Khit caves in Dagestan (Narochnitskiy, 1988).

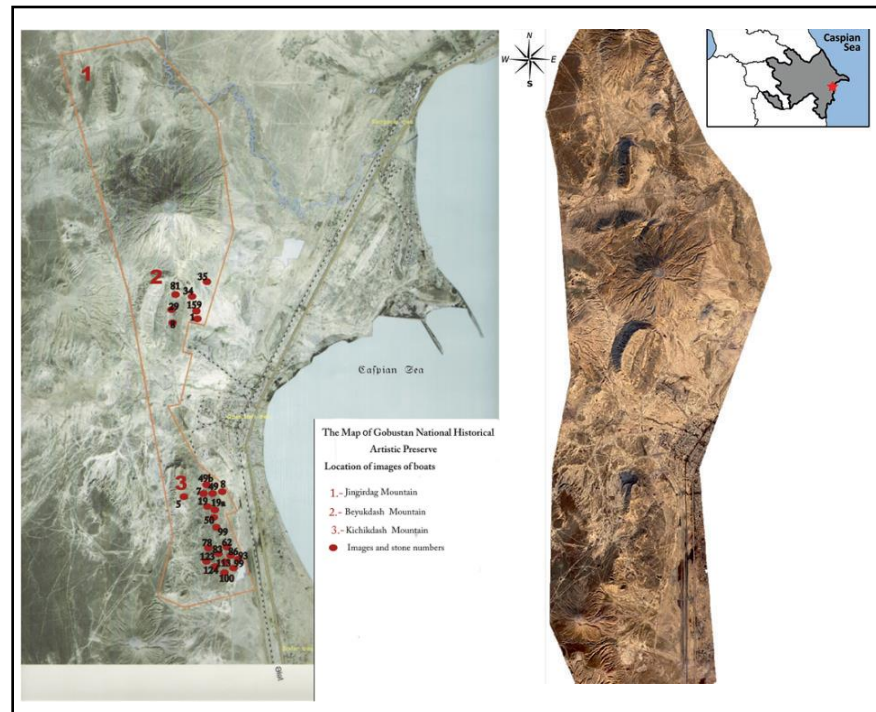
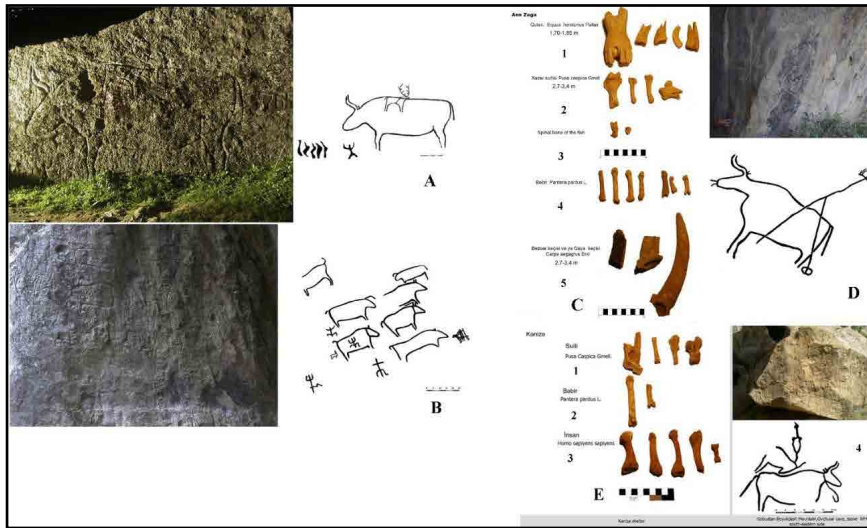


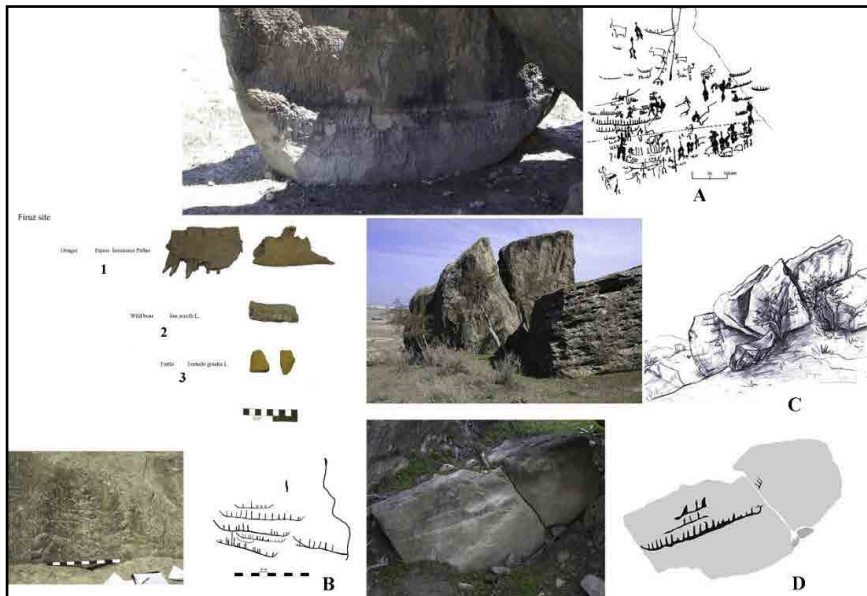
Fig. 3: The geographical location of the rock arts and sites complex in Gobuстан region (Farajova, 2017; Sigari et al., 2019). ►

- Northern Caspian Sea

The Mesolithic in the northern part of the Caspian Sea should be observed more in the Volga River basin. The Mesolithic in this part of the Caspian



◀ Fig. 4: A) Aurochs, deer, and pregnant women from Ana Zaga Cave, upper Paleolithic (Farajova, 2017); B) aurochs motives from Ana Zaga, upper Paleolithic (Farajova, 2017); C) Bones of animals found in Ana Zaga cave, 1- Caspian or Turkmen wild donkey from Mesolithic layers, 2- Caspian seal, 3- Fish, 4- Wild leopard, 5- Caucasian bezoar goat from Upper Paleolithic layers (Farajova, 2018); D) motif of aurochs from Mesolithic period (Farajova, 2017); E) 1- Caspian seal bone 2- Wild leopard 3- Human bone from the Kaniza, Mesolithic period; 4- aurochs motif from Ovchular Cave, Mesolithic period (Farajova, 2018).



◀ Fig. 5: Rock motifs of boats: A) Kichikdash mountains, Mesolithic period; B) Patterns of boats and animal bones: 1- wild zebra 2- wild boar 3- turtles from Firuz, Mesolithic period C) Firuz; D) Firouz II (Farajova, 2017).

Sea includes two periods: Early Mesolithic from 10,000 to 9,000 BP, and the late Mesolithic from 9,000 to 8,000 BP (Anthony, 2007a: 351, 353). In the Early Mesolithic camps such as Burovaya53 and Je-Kalgan in the northern Caspian desert, Mesolithic wastes are almost exclusively small zebra³ bones (Gorashchuk & Komarov, 1998). In some sites, sandy mound cover and protect Early Mesolithic sites with a steppe environment, such as Je-Kalgan with 2×3m dimensions. Flint chipped stones included many geometric microliths, micro-chisels, and blunted blades with few scrapers. Chipped stones in this period include many end scrapers on the blades, microblade with retouched of 5-7mm, diagonal microblade, short parallelograms, trapezoids, and short crescents with two-sided retouch, and geometric microliths which were produced less than the previous period.

One of the key sites for the Late Mesolithic is Istai IV. In this site, as in other Late Mesolithic sites, hunters used different gray flints than in the Early Mesolithic (Anthony, 2007a) (Fig. 6).

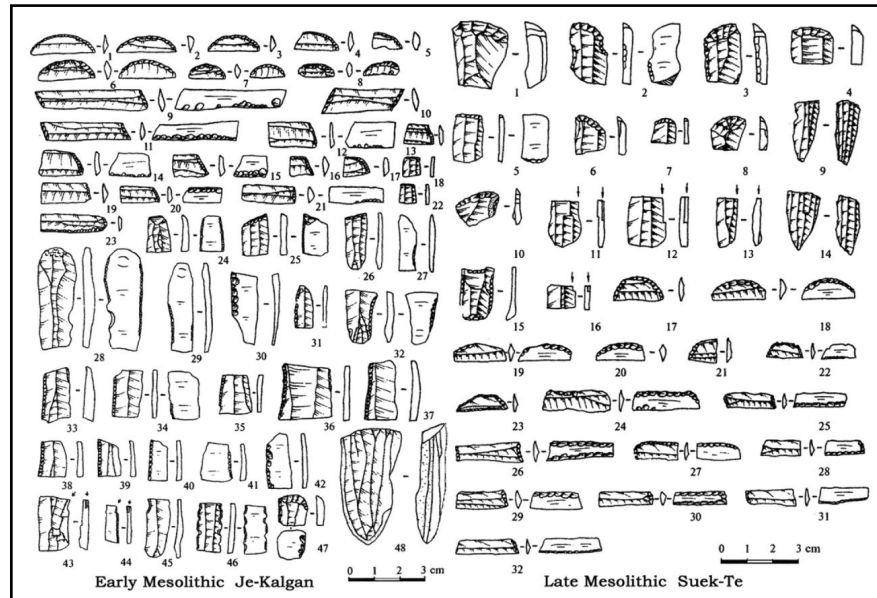


Fig. 6: Lithic artifacts of the northern Caspian Sea basin from the Early and Late Mesolithic (Vasiliev et al., 1996). ▶

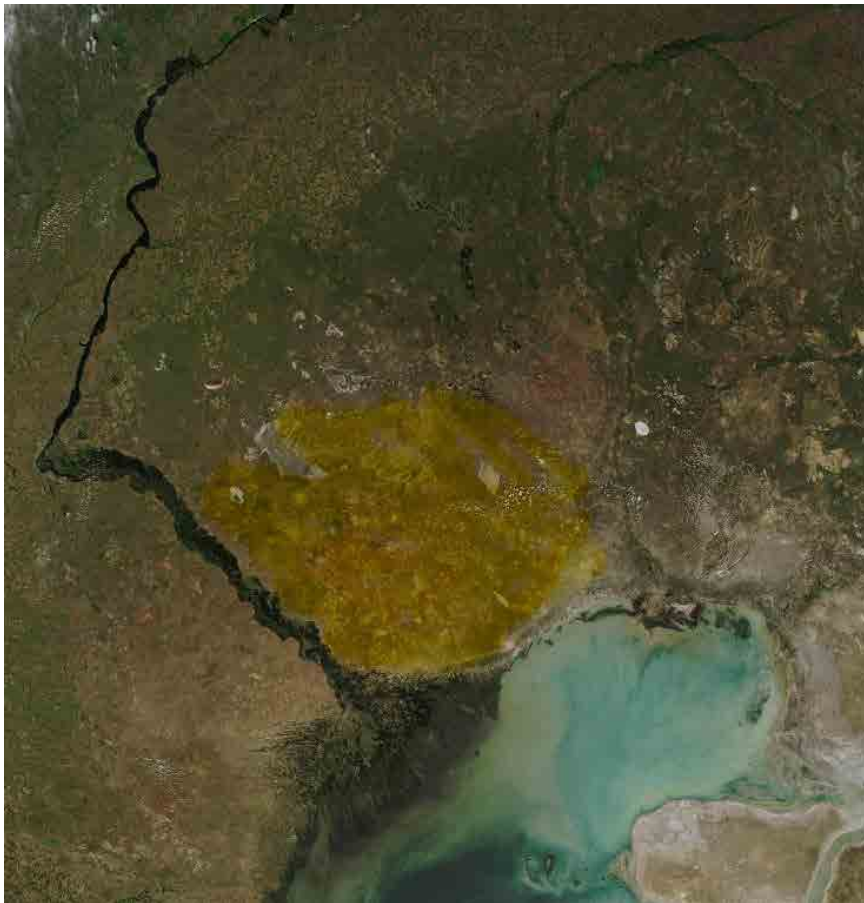
Table 2: Comparison of Archaeological periods, sea fluctuations, and climate changes in the western and northern parts of Caspian Sea (Authors). ▶

Geology period	Archaeological Sites and Periods			Sea Level Changes		Climate period
	Period	West	North	Period	Date (BP)	
Holocene	Mesolithic	Gobustan Complex 10000-9000 BP	Lower Volga 10000-8000 BP	8.4k Regression	8400	Holocene
				Neo-Caspian Transgression	10590-8400	
Pleistocene	Upper Paleolithic	Gobustan Complex 14000-10000 BP	-----	Mangyshlak Regression	11900-10500	Younger Dryas 12800-11550 BP
				Late Khvalynian Transgression	18000-12000	

Caspian Sea Level Changes During Late Pleistocene and Early Holocene

The Late Pleistocene and Early Holocene were associated with important changes in terms of paleo-climatic conditions. During this time, the Caspian Sea coast experienced frequent, rapid, and extensive changes from fully marine environments to shallow wetlands with major impacts on salinity and vegetation (Map 1). Unlike the other three parts, in the northern region of the Caspian Sea there is no evidence of occupation until at least 10,000 BP due to the Khvalynian transgression and then the deep Mangyshlak regression. The faunal assemblage of the northern Caspian plains (the upper basins of the Volga River) indicates a cold and dry climate, while the palynology studies of the Athelian deposits (after 18,000 BP) indicate

a change to a warmer climate (Költringer et al., 2020; Yanina, 2014), which is simultaneous with the beginning of the late Khvalynian. The late Khvalynian transgression was traced until 14,000 years ago in the northern basin of the Caspian Sea up to the city of Saratov⁴, and for this reason, no settlement is observed. About 12,000 years ago, the final regression of the late Khvalynian period turned these plains into a desert with harsh conditions, known as the Red Sands Desert or Ryn Peski (Fig. 7), which now exists in the north of the Caspian Sea. After the beginning of the Holocene period and about 10,000 years ago, hot and humid weather placed in the region, and this desert turned into steppe plains, and the Mesolithic sites were formed in this region; Of course, during the following periods, depending on the weather conditions, the Red Sands Desert turned into steppe or desert plains, which now it is still a desert plain (Anthony, 2007a).



◀ Fig. 7: The Red Sand desert: (http://visibleearth.nasa.gov/view_rec.php?id=3823).

- The Khvalynian Transgression

With the beginning of the warm and humid Allerød period, which was probably simultaneous with the late Khvalynian transgression, 18,000-12,000 BP (Bezrodnykh & Sorokin, 2016), the improvement of climatic

conditions also can be seen in the vegetation (Leroy et al., 2013; 2019) (Map 1). The landscape of this period corresponds to the forest steppes along the coast, and Gorgan Bay was probably very large during this period due to the high sea level. In the southern Caspian Sea, the first settlements of the Mesolithic period (the Early Mesolithic layers of the Kamarband Cave and the lower deposits of the Hotu Cave) occurred during the Khvalynian transgression, between 15,000 and 13,000 BP. The proximity of the sea to the caves and the narrow coastal plain has facilitated the transfer of seals to the settlement sites. In addition, the hunting of birds, most of which were probably large and from the waterfowl species (Coon, 1951), competes with the seal as a food source. During this period, the presence of birds from the species of partridges, pigeons, and tuka, which were reported from Hotu Cave, could indicate the woodland and shrubbery ecosystem. Mesolithic sites in the eastern Caspian Sea were formed in lowland areas around the sea (Krasnovodsk Peninsula and Kara-Bogaz-Gol Gulf), which were submerged during the Khvalynian transgression. Therefore, it became possible to be occupied after the end of the Khvalynian transgression and during the Mangyshlak regression.

In the western part, the ancient sites near the sea, in the Gobuстан region, are formed from the middle of the late Khvalynian transgression, simultaneously with the Upper Paleolithic of the Caucasus. The Upper Paleolithic itself is divided into two sub-phases, the first phase of which is related to 12,000-14,000 BP. Images of heads and full bodies of aurochs in Gaya Arasy Cave in Kichikdash Mountain and life-size in Ana Zaga Cave in Buyukdash Mountain belong to the Early Upper Paleolithic. The sites of Gobuстан are located at heights between 100 and 400 meters, which were safe heights for hunters during the Upper Paleolithic and Mesolithic periods and the sea transgression (Farajova, 2018). Sigari believes that the entire region except for small island areas related to the peaks of Kichikdash, Buyukdash, Jingirdagh-Yazili, Songardagh, and Sikh Gaya hills, were submerged (Sigari, 2016).

- The Mangyshlak Regression

At the end of the Pleistocene and before the beginning of the warm Holocene period, the cold and dry global phenomenon of the Younger Dryas occurred between 12800-11500 BP (Rusmussen, et. al., 2006). Mangyshlak regression in 10500-11900 BP (Bezrodnykh & Sorokin, 2016), which caused the sea level to drop to -53 to -113 meters, may have been due to the effects of the Younger Dryas (Map 1). The Study of pollen in Mangyshlak sediments indicates the absence or a small number

of tree species and the dominance of steppe and semi-desert environments related species. The weather probably was dry and colder than the previous conditions (Bezrodnykh & Sorokin, 2016). At this time, a large coastal plain was extended in front of the sites of the southern sea, and Gorgan Bay was very small or did not exist at all due to the regression (Leroy et al., 2018; 2019). Leroy and her colleagues considered the slight decrease in trees and the forest-steppe environment of this period as a reflection of the climatic conditions away from the glacial environment, and this region with a rich environment is suitable for the wide range of mammal species and as a result, for the continuity of human habitation (Leroy et al., 2019). The Late Mesolithic, which includes the lower layers in the Kamarband Cave known as the Gazelle Mesolithic, the lower layers in the Hotu Cave known as the Rodent Mesolithic (the upper deposits of Trench D), the upper layers of Komishan Cave, the lower layers of Al Tappeh Cave and the oldest Mesolithic layers of the Komishani open site (11200 BP) is placed in the stage of Mangyshlak regression (the beginning of regression is around 11900 BP).

The lack of seals, the increase and focus on gazelles, the abundance of small mammals such as mice and rabbits, and the evidence of the presence of goats and sheep among the animal remains, indicate the wide range of diet of the inhabitants of these sites and less dependence on marine resources during the period of sea regression. The presence of two birds, black-bellied grouse, and gray partridge, in Komishan cave, is attributed to the steppe environment, which can represent the cold and dry weather period of the Younger Dryas. The relative chronology and typology of the find assemblages from the eastern Caspian Sea sites indicate a date after the end of the Khvalynian transgression and the beginning of occupation at 12000 BP, that is, at the same time as the Mangyshlak regression. The oldest Mesolithic layers in the east of the Caspian Sea include layer 5 at the Dam-Dam Cheshme 1, layers 9 to 6 at the Dam-Dam Cheshme 2, layers 8 and 7 of Djebel, the Mesolithic layers of Hodja-su, and the lower layers of Kaylu and Kuba-Sengir. The subsistence of the inhabitants of this period was mainly based on hunting, gathering, and fishing. The abundant fish bones, including sturgeon and local oyster species, indicate that the sea was still near these sites. In the western region, this period is simultaneous with the second phase of the Upper Paleolithic in Gobustan, which dated between 12,000-10,000 BP. In this period, based on the rock arts found in Gaya Arasy and Ana Zaga, animals such as aurochs, horses, ungulates (Capra or deer), and Caniformia were hunted (Sigari, 2013, 2019;

Farajova, 2017, 2018). There is a problem in terms of chronology. While Farajova introduces both sites of Gaya Arasy and Ana Zaga in his two articles related to the period of 14,000-12,000 BP, however, in an absolute chronology table (13,700 BP), Gaya Arasy is related to the end of the late Khvalynian transgression and Ana Zaga cave (10,400 BP) simultaneous with Mangyshlak regression (Farajova, 2017). This dating problem has caused ambiguity in several issues, including the existence of boat rock arts near Ana Zaga at the Mangyshlak regression period.

- The Neo-Caspian Transgression and 8.4K Regression

At the beginning of the Holocene, the Caspian Sea level gradually raised during the so-called Neo-Caspian advance. The evidence of this transgression, which continued from 10,590 to 8,400 BP, has been identified in the form of layers of dark silt and clay among the sediments. Then, around 8400 BP, another regression occurred in the Caspian Sea, which was visible until 7710 BP, and the area of the sea almost reached today's size (Kakroodi et al., 2015; Kakroodi, 2012) (Map 1).

Palynological evidence indicates a change from arid to semi-arid environmental conditions and from desert-steppe to shrub and bush species (Rahimzadeh et al., 2019). The influx of large volumes of water from the Uzboi river in northwestern Turkmenistan and the Volga from Russia (Leroy et al., 2013) caused the Caspian Sea to reach its highest maximum after the Mangyshlak regression between 10500-8400 BP and the vegetation also have been improved (Kakroodi et al., 2015). The uppermost Mesolithic layers in Kamarband, Hotu, Al Tappeh, and Komishan caves are simultaneous with the Early Holocene, which begins at 10,600 BP. This period was the last stage of the abundance of gazelle hunting among other animals, and opposite, the intensity and importance of goats and sheep as an important game increased. In addition, the presence of Sacred Ibis from layers 1-4 of square D, and Great White Stork from layers 3-6 of square A excavated in Komishan cave indicates a wetland and swamp environment that can represent a warm and humid climate (Vahdati Nasab et al., 2020). The faunal assemblage of the Mesolithic layers from the Komishani open site dated 10,600 BP, includes the remains of sheep, goats, pigs, and birds (Leroy et al., 2019: T2). Chronology in the southeast of the Caspian Sea suggests a date between 10,200 and 9,800 BP for the beginning of the PPN. The abundance of goats and sheep in this period in Hotu and Kamarband caves made Coon consider them domesticated.

With the beginning of the PN period, which is dated between 8600 and 8400 BP and is associated with the 8.4K regression, PN sites appear throughout the southeastern plains of the Caspian Sea, as well as in the highlands. Coon also states that pigs and cattle were domesticated during this period. Even though Coon claims the domestication of goats, sheep, pigs, and cattle, his opinions are highly doubtful, and his tasteful selection and analysis prevent reliable results (Uerpmann & Frey, 1981; Harris, 2010; Abbasnejad Serešti et al., in press). Faunal remains from Komishani open site (Leroy et al., 2019: T2) and Hotu Cave (De Groene et al., 2023) from the PPN and PN, do not show any evidence of domesticated species, and all the faunal remains belong to wild species; Although Gregg and Slater found fat molecules in Hotu and Kamarband potteries from Coon's excavations (Gregg & Slater, 2012: 1782), and also the presence of PN sites at highlands with elevations between 800m and 2000m can be related to the pastoral economy (Asadi Ojaei, 2023).

In the east of the Caspian Sea, at the end of the 7th and the beginning of the 6th millennium BC (layers 5a, 5-6, and 6 Djebel), the transition from the Mesolithic to the Neolithic is simultaneous with the early phase of Kelteminar culture (Coolidge, 2005: Fig. 2.1). In this period, along with fishing and hunting, the abundant remains of goats and sheep (in the Dam-Dam-Cheshme 2) were obtained. A large amount of goat and sheep bones in layers 6 and 5, related to the Mesolithic period, and at the end of layer 5 and the beginning of layer 4, related to the transition from the Mesolithic to the Neolithic in Dam-Dam-Chashme 2 indicates that the first attempts at domestication were made before the 7th millennium BC (Kohl, 1984: 42; Masson & Sarianidy, 1972: 29). Based on faunal evidence which was not enough (Harris, 2010: 58), Markov concludes the domestication of goats and then sheep along with hunting and fishing, however, the lack of cereal cultivation evidence and the remains of domesticated livestock prevents a definitive interpretation about how domestication begins on the eastern Caspian Sea. The lithic assemblage is usually related to the short-term establishment of sites for fishing, hunting, and food preparation. Although the presence of pottery sherds in Dam-Dam-Cheshme 2 can indicate long-term occupation, there is a possibility that it is related to the use of rock shelters by nomadic herders. The absence of long blades for cutting plants and mortars that indicate the use of grains or other seeds, confirms the interpretation that the sites on the eastern Caspian Sea were mainly used for hunting and fishing (Harris, 2010: 205).

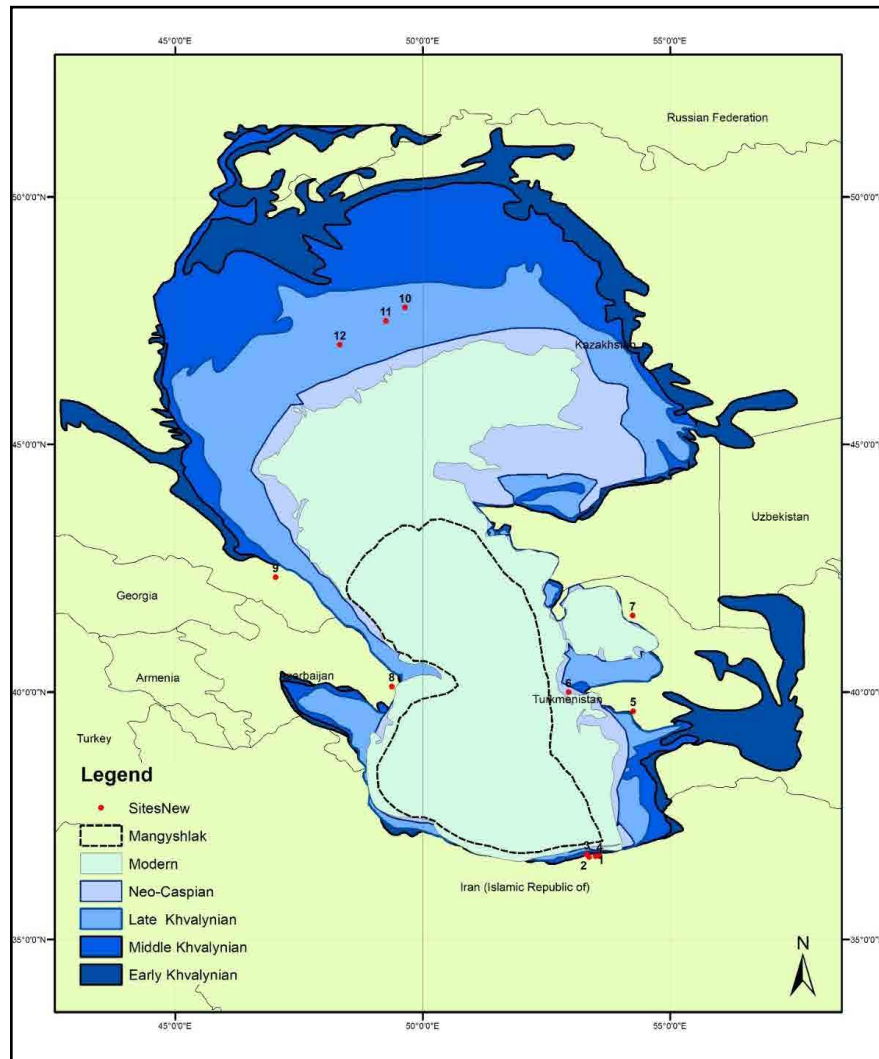
In this period, the Mesolithic begins in the western part, and for the first time, in the northern part of the Caspian Sea. Due to the hot and humid climate, Gobuстан Plain has turned into a semi-arid environment with scattered trees and steppe grasslands, which is a good place for grazing gazelles and Turkmenian kulan, however, gazelles with 98% in faunal remains are the dominant species. In this period, marine resources such as fish and seals also existed in the subsistence chain of communities, which is related to the designs of boats in Firoz II at the end of the Mesolithic and the beginning of the Neolithic, dated between 8700 to 7800 BP (Sigari, 2016; Farajova, 2018). In the site of Firuz, the burial of a child and 10 adults from 10,000 BP were found along with pendants and objects, some of which are known as tools for weaving fishing nets (Rustamov, 2006). The presence of 11 people in one burial and the possibility that these people drowned in the water in an event, perhaps during fishing, is a sign of the importance and specialization of fishing. Also, this issue can clarify the problem of the boat motives in Ana Zaga related to the end of the Mangyshlak regression and the beginning of the Neo-Caspian transgression.

In the northern part, where settlements begin in this period, in the Early Mesolithic (9000-10000 BP), the climate was colder and more humid than today, and numerous lakes covered the grasslands. It seems that the Early Mesolithic camps were very small and included hunter-family groups. The scattering of tools and animal bones in Je-Kalgan covered an area of 10×10m, and other sites were even smaller. Many of them, instead of on top of the hills, were located in lowlands or shallow pits. Late Mesolithic camps were larger than the previous period; For example, Suck-Te was an area of 40×60m. Hunting zebra, wild horses, and saiga antelope provided most of the dietary protein throughout the Mesolithic (Kuzmina, 1988; Anthony, 2007b). However, no soil sieving or flotation or use of field methods capable of recovering fish and small animal bones has been done. Late Mesolithic sites are often found on top of mounds rather than in shallow pits; towards the north and east sides, there were Early Mesolithic hunting sites (Anthony, 2007a). During the late Mesolithic (8000-9000 BP), the North Caspian plains increasingly turned into a desert. Palynological evidence indicates that desert conditions expanded with a peak period of drought around 8000 BP, and then humid conditions returned. The dry period is probably related to the cold oscillation that occurred around 8200 BP across the northern hemisphere (Perry and Hsu, 2000).

It seems that the Caspian Sea and its surrounding regions provided reliable food sources, thus, the production of food and domesticated species occurred later than domestication centers such as the Fertile Crescent. In the western and northern coasts, food production and domesticated species do not appear until 8400 BP climate changes. Vasiliev and other scholars, in the Late Mesolithic lithic assemblages, found important similarities among many food-gathering groups of the steppe plains, including north Caspian steppes (Istai IV type), west Caspian steppes (Kharba type) and the Azov steppes of Crimea. Vasiliev states that the Azov-Caspian arid steppes form a “cultural zone” during the Late Mesolithic and Early Neolithic; a network of food-gatherer groups that had interaction with each other and used same microlith-making traditions (Vasiliev et al., 1996). In the northern part of the Caspian Sea, the latest dates indicate the beginning of the Neolithic period from 8500-7400 BP. Wild species were dominant in the sites of the Kairshak and Tenteksor in the north of the Caspian Sea, in the sites of the Jungar culture located in the northwest of the Caspian Sea region, and in the sites of the Neolithic Orlovskaya culture in the lower Volga region. In the Eneolithic (Chalcolithic) period, in sites such as Kairshak VI and Kombakte, which dated between 7300-6400 BP, although still hunting wild animals such as donkeys, saiga antelope, aurochs, red deer, Eurasian horse, and Corsica fox were common, for the first time the bones of domestic animals including sheep and cattle were identified (Vybornov et al., 2018). The first Neolithic sites in Eastern Europe (Ukraine) indicate cattle and domestic pig herding in an older time, around 7500 BP (Anthony, 2007a), according to the common lithic tradition between the two regions, eastern Europe and the northern basin of the Caspian Sea show extensive connections.

In the western part of the Caspian Sea, the nearest Neolithic sites in the South-Eastern Caucasus, such as Kamiltepe (early 6th millennium BC) at a distance of 160 km and Alikemek Tepesi (late 6th and early 5th millennium BC) at a distance of 50 km from the sea presents domestic species such as cattle, then goats, sheep and pigs (Sagona, 2018; Ritchie et al., 2021; Berthon, 2014). According to the rock motifs found in Gobustan during the Neolithic period (9000-8000 BP), the same wild species, plus wild boar, are present in the subsistence package of the communities of the western shores of the Caspian Sea. Also, some researchers claim that the reduction in the size of aurochs horns is a sign of its domestication, but Sigari believes that although the horns are getting smaller, they are longer than before; in the Eneolithic, which dated between 8000 to 6000 BP, motives include

deer, goat, wild boar, and domesticated aurochs (Farajova, 2017, 2018; Sigari, 2013). Therefore, the only evidence of the presence of domesticated species near the western shores of the Caspian Sea is the rock arts of aurochs and the size of their horns, which cannot be very reliable, but the evidence of the distribution of domesticated species from Kamiltepe and Alikemek Tepesi, respectively, can help us to draw this distribution pattern toward the western Caspian Sea.



Map 1: Transgressions and regressions of the Caspian Sea and the locations of the Mesolithic and Neolithic sites around it (Authors): 1) Hotu and Kamarband, 2) Komishan and Komishani, 3) Touq Tappeh and Tappeh Veliki, 4) Al Tappeh, 5) Dam-Dam Cheshme 1 & 2, 6) Kaylu and Kuba-Sengir 7) Hodja-Su, 8) Gobušan complex, 9) Chokh, 10) Suek-te, 11) Je-Kalgan, 12) Kairshak. ▶

Conclusion

In the transgression of Khvalynin, marine resources were dominant, as in the southern part and in Hotu and Kamarband caves from the Early Mesolithic. This period was named Mesolithic Seals. The importance of this resources can be due to adaptation to climate changes and the Caspian Sea transgression. Then, when Mangyshlak regression occurs, human communities adapt themselves in the southern part of the Caspian Sea and

therefore, seals decrease and gazelles and medium-sized mammals become the most abundant and important diet. In the eastern part of the Caspian Sea, in the late Khvalynian, the region was submerged; on the opposite, in Mangyshlak regression, the sea was not far from the sites. The presence of seashells and abundant fish remains indicate the importance of the sea in the subsistence of the residents of this region. On the southern shores of the Caspian Sea, the Neo-Caspian transgression is Simultaneous with the PPN, and 8.4K regression is simultaneous with the PN period; on the eastern shores, respectively, they are simultaneous with the transition from the Mesolithic to the Neolithic and the beginning of Kelteminar culture. In both of these regions, the beginning of domestication has been reported based on unreliable evidence and based on the increase in the number of goats and sheep remains. In addition, the latest excavations in Hotu Cave confirm the absence of domesticated animals. Therefore, the issue of domesticated species and food production remains unsolved even after the PN period.

In the west, coastal shores were submerged and mountains become islands in the middle of the waters during the Late Khvalynian transgression. According to rock art, the aurochs are the dominant species. Mngyshlak regression caused the western part turned from an island state into a coastal plain, and in addition to the aurochs, horses, and deer were added to their subsistence. Because of the improvement of the weather conditions at the early Holocene and the Neo-Caspian transgression, gazelle became a popular species in the subsistence of the societies of the western part, and along with it, seals and fish also added to the faunal complex; the weaving of fishing nets and a large number of boat motives are signs of the fishing specialization in the western part. In the northern part, where the first settlements began in the Neo-Caspian transgression, the hunting of zebra, wild horse, and saiga antelope can be identified in the Mesolithic period, which lasted until the 8.4K regression; however, due to the lack of excavations and appropriate material collecting practices, there is no proper understanding of the use of marine species.

The rich environment and being far from the main center of domestication, i.e. the Fertile Crescent, which is separated by the Taurus and Caucasus mountains, caused that domesticated species appear very later in the western and northern parts; in the north, the first domesticated species are sheep and cattle that appeared in 7300 BP during the Eneolithic. In the western part, the only evidence of domesticated species is the decrease in the size of aurochs horns in the Early Neolithic rock arts, simultaneous

with the Neo-Caspian transgression. Even until the Eneolithic period, there is no evidence of domesticated species in this region. The Caspian Sea has been a great resource for the inhabitants around itself in different periods. The world's largest lake has generously provided food and raw resources for prehistoric communities since 16,000 BP. Many plant and animal species came together around this lake, which belong to different environments. Due to the richness of the ecosystem, the communities of this region were self-sufficient and exploited the wild resources at least until Chalcolithic.

Endnote

1. Above Mean Sea Level
2. wild Turkmen or Caspian donkeys
3. *Equus hemionus*
4. 600 kilometers far from today Caspian Sea shores

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بررسی تأثیر رویدادهای اقلیمی بر معیشت جوامع میان‌سنگی و نوسنگی پیرامون دریای کاسپی

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چکیده

تغییرات اقلیمی در پلیستوسن پایانی و هولوسن آغازین که تأثیر زیادی در پیش‌روی و پس‌روی آب دریای کاسپی داشت، هم‌زمان با استقرارهای میان‌سنگی و نوسنگی در سواحل دریا رخ داده‌اند. نوسانات مکرر سطح آب دریای کاسپی به‌طور مستقیم و غیرمستقیم سکونتگاه‌های اولیه جوامع پیش‌ازتاریخ پیرامون دریای کاسپی را تحت تأثیر قرار داده است. پیش‌روی‌های خوالین (۱۸۰۰۰-۱۲۰۰۰ سال قبل) و نئوکاسپی (۱۰۶۰۰-۸۴۰۰ سال قبل) سبب شد که در کنار دیگر منابع، گونه‌های آبی و دریایی سهم به‌سزایی در معیشت این جوامع ایفا کنند. پس‌روی‌های منگیشلک (۱۲۰۰۰-۱۰۵۰۰ سال قبل) و ۸,۴k سبب فاصله زیاد بین محوطه‌های استقرارشناسایی شده و کرانه‌های دریا و درپی آن، کاهش استفاده از منابع دریایی در معیشت ساکنین شد؛ اما در مقابل، موجب شکل‌گیری زیست‌بوم‌های غنی برای جانوران و گیاهان جدید هم‌چون غزال، بز و گوسفند شد. در سواحل جنوب شرقی دریای کاسپی، آغاز استقرارهای میان‌سنگی تقریباً هم‌زمان با پیش‌روی خوالین و نزدیکی سواحل به محوطه‌های استقراری بوده است و این استقرارها تا دوره‌های بعد به‌طور پیوسته ادامه داشته است. در شرق دریای کاسپی، استقرارها پس از پایان پیش‌روی خوالین و در طی پس‌روی منگیشلک آغاز شد. در طی این دوره دریا هم‌چنان در نزدیکی محوطه‌های استقراری بوده است؛ درحالی‌که در غرب در میانه خوالین، جوامع در دوره پارینه‌سنگی جدید قرار داشتند و در شمال تا حدود ۱۰۰۰۰ سال پیش، هیچ استقراری وجود نداشته است. این درحالی است که تقریباً اغلب مناطق غرب آسیا در پایان پلیستوسن و گذار به دوره هولوسن، به‌سوی اهلی‌سازی و تولید غذا از گونه‌های اهلی پیش‌رفته‌اند؛ غنای نواحی پیرامون دریای کاسپی و دور بودن از مرکز اصلی اهلی‌سازی، یعنی هلال حاصلخیزی موجب شده تا نوسنگی و ظهور گونه‌های اهلی شده بسیار دیرتر صورت گیرد. تنوع زیاد منابع تا اندازه‌ای پاسخ‌گوی نیازهای معیشتی جوامع آن بوده و اولین گونه‌های اهلی، آن‌هم تنها در غرب و شمال از دوره مس‌وسنگ پدیدار شدند.

کلیدواژگان: رویدادهای اقلیمی، معیشت میان‌سنگی و نوسنگی، سواحل دریای کاسپی، پلیستوسن و هولوسن، پیش‌روی‌ها و پس‌روی‌های دریای کاسپی، اهلی‌سازی و تولید غذا.

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